



Project Title: “Steam Injection into Fractured Bedrock at Loring Air Force Base”

Principle Investigator: Eva Davis (USEPA/ORD/NRMRL/GWERD; Ada, OK 74820; 580-436-8548)

Collaborators: Maine Department of Environmental Protection, EPA Region I, SteamTech Environmental Services, Queens University, University of California – Berkeley, US Geological Survey

Introduction to the problem: Hundreds of contaminated sites exist where most or all of the subsurface contamination resides in fractured bedrock. Due to the complexity of the hydrogeologic systems in fractured bedrock, few remediations have been attempted.

Background: Over 450 drums that contained spent solvents were disposed of in the Loring AFB Quarry. Groundwater sampling below where the drums had been buried revealed groundwater contamination from leaking drums consisting of mostly tetrachloroethene (PCE). A research project was undertaken on steam injection remediation in fractured rock.

Objectives: 1) Determine if steam injection can be used to heat fractured bedrock 2) Determine if steam injection can enhance the recovery of volatile contaminants from fractured limestone, 3) Evaluate changes in rock and groundwater concentrations due to the steam injection, 4) Evaluate horizontal and vertical migration of contaminants from the treatment zone during steam injection, 5) Evaluate the use of electrical resistance tomography and borehole radar tomography to track steam/heat fronts in fractured limestone

Approach: Site characterization activities including sampling of rock to determine contaminant concentrations, discrete interval transmissivity testing, and discrete interval groundwater sampling was carried out and interconnectivity testing was performed. Based on all of the characterization data, a steam injection, extraction and monitoring system was designed and constructed. Steam injection was initiated in September 2002, and continued for 80 days. Concurrently vapors and groundwater were extracted and analyzed. In May 2003 the first round of post treatment groundwater samples was obtained, and in July post treatment rock chip samples were obtained.

Accomplishments to date (August 2003): Effluent sampling during the steam injection showed that aqueous and vapor phase concentrations increased starting about three weeks after steam injection was initiated, and they continued to increase throughout the rest of the steam injection. Steam injection was halted due to lack of sufficient funding, rather than due to completion of the remediation. The first round of post treatment groundwater samples show a decrease in groundwater concentrations in most of the area. The post treatment rock chip samples seems to show an overall decline in contaminant concentrations in the rock. Groundwater sampling indicates vertical and hydraulic migration did not occur.

Near future tasks: Two additional rounds of post treatment groundwater samples will be obtained in October 2003 and May 2004. Tracer testing will be performed starting in August 2003.